CHM113 General Chemistry I

Practice

How many grams of Mg_3N_2 can be formed from 10.0 g of Mg and 20.0 g of N_2? How much of the excess reagent is left after the reaction is complete? If 12.3 g of Mg_3N_2 are actually collected, what is the percent yield?

(in grams)

Know

$3\,Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$

10.0 g — 20.0 g — actual yield = 12.3 g

24.31 g/mol — 28.02 g/mol — 100.95 g/mol

want: a. grams Mg_3N_2; b. excess reagent mass; c. % yield

a. Convert to moles

$10.0\,g\,Mg \times \frac{1\,mol\,Mg}{24.31\,g\,Mg} = 0.411\,mol\,Mg$

$20.0\,g\,N_2 \times \frac{1\,mol\,N_2}{28.02\,g\,N_2} = 0.714\,mol\,N_2$

b. Determine required

$0.411\,mol\,Mg \times \frac{1\,mol\,N_2}{3\,mol\,Mg} = 0.137\,mol\,N_2\ req.$

$0.714\,mol\,N_2 \times \frac{3\,mol\,Mg}{1\,mol\,N_2} = 2.14\,mol\,Mg\ req.$

c. Compare

	Mg	N_2	
Have	0.411	0.714	← excess reactant
Need	2.14	0.137	

↑ limiting reagent

grams Mg_3N_2

$0.411\,mol\,Mg \times \frac{1\,mol\,Mg_3N_2}{3\,mol\,Mg} \times \frac{100.95\,g\,Mg_3N_2}{1\,mol\,Mg_3N_2} = 13.8\,g\,Mg_3N_2$

excess reagent mass

$0.714\,moles\,N_2 - 0.137\,mol\,N_2\ consumed = 0.577\,moles\ remain\ of\ N_2$

$0.577\,mol\,N_2 \times \frac{28.02\,g\,N_2}{1\,mol\,N_2} = 16.2\,g\,N_2\ remain$ ← makes sense b/c less than what you started with

% yield

theoretical yield = 13.8 g Mg_3N_2

actual yield = 12.3 g Mg_3N_2

$\%\ yield = \frac{12.3\,g\,Mg_3N_2}{13.8\,g\,Mg_3N_2} \times 100 = 89.1\%\ yield$